

Charting the Way Forward to Cadmium and Hexavalent Chromium Free Connectors: NAVSEA Usage and Testing

ASETSDefense 2012: Workshop on Sustainable Surface Engineering for Aerospace and Defense

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Agenda

- **Overview**
- **Navy Connectors**
- **Specification Work**
- **Collecting the Data**
- **Understanding the Data**
- **NSWCDD—Test Efforts for M28876 Fiber Optic Connectors**
- **Wrap Up**

Overview

- **Going cadmium and hexavalent chromium “free”**
 - Many alternatives exist but few qualified connectors without cadmium and/or hexavalent chromium exist
 - < 0.1 percent by weight of hexavalent chromium is allowed
- **Without qualified cadmium and hexavalent chromium free connectors available to existing and future programs:**
 - Waivers for qualified cadmium connectors will not continue
 - Waivers for non-qualified connectors increase risk to performance requirements

Meeting performance and regulation at the same time.

Navy Connectors

| | Allowed non-cadmium platings or finishes* | | | | | | | Status |
|----------------|---|------------------------|--------------------|-------------|--------------------|---------------------------|----------------------|--------------------|
| | Cadmium | Electroplated Aluminum | Electroplated ZnNi | Nickel PTFE | Electroless Nickel | Corrosion Resistant Steel | Other** | |
| MIL-DTL-3607C | X | X | X | X | X | | Silver, Tin | Active |
| MIL-DTL-12520D | X | | | | | X | Zincated Al w/copper | Not for New Design |
| MIL-DTL-21097G | X | | | | | Passivated | | Active |
| MIL-DTL-21617A | X | | | | | | | Active |
| MIL-DTL-22992G | X | X | X | X | | X | Hard oxide | Active |
| MIL-DTL-24308G | X | X | X | X | X | Passivated | Zinc, tin, gold | Active |
| MIL-DTL-25955A | X | | | | | | Gold, tin | Not for New Design |
| MIL-DTL-26482H | X | X | X† | X | X | | | Active |
| MIL-DTL-27599D | X | X | X | X | | | | Not for New Design |
| MIL-DTL-28731F | X | | | | | X | | Active |
| MIL-DTL-28748D | X | | | | | Passivated | Zinc, anodized AA | Active |
| MIL-DTL-28840C | X | X | X | X | | | | Active |
| MIL-DTL-32139A | X | X | X | X | X | Passivated | Titanium | Active |
| MIL-DTL-38999L | X | X | X† | X† | X† | Passivated | Tin, anodized | Active |
| MIL-DTL-55181E | X | | | | X | Passivated | | Active |
| MIL-C-81511F | X | | | | X | | Tin | Not for New Design |
| MIL-C-81582B | X | | | | | | | Active |
| MIL-DTL-83513G | X | X† | X | X | X | Passivated | | Active |
| MIL-DTL-83527B | X | | | | | | | Active |
| MIL-DTL-83723G | X | X | X | X | X | Passivated | Tin, anodized AA | Active |
| MIL-PRF-28876E | Compatible | | | | | Passivated | Any | Active |
| MIL-PRF-64266 | | | | | | Passivated | Any | Active |
| SAE-AS-50151 | X | | | | X | Passivated | Tin | Active |
| SAE-AS-81659 | X | | | | X | | | Active |
| SAE-AS-85049A | X | X | X | X | X | Passivated | Black anodize | Active |

*Finishes are typically selected by connector class. Not all finishes or platings are available for all classes. Some classes of connectors still require cadmium to meet performance requirements, but others could be replaced by currently allowed alternative plating/finish classes.

** Other finishes or platings may only be appropriate for a limited selection of parts, e.g., contacts, and not allowable on backshells, etc. PRF specifications do not explicitly specify platings, only that they must meet performance requirements.

†A qualified connector with alternative plating on Qualified Parts List is available.

Specification Work

- **Searchable database of connector specifications created at Naval Surface Warfare Center, Dahlgren Division (NSWCDD)**
- **Generated reports provide information and guidance:**
 - What are my performance requirements?
 - What is the level of risk associated with a coating change for each performance requirement?
 - Possibilities for qualification by similarity
 - Generic test plan based on high and medium risk to performance requirements
 - Known “gotchas” of changing from cadmium to an alternative
- **Will update and adapt information as additional test data is obtained.**

Collecting the Data

- **Enormous body of work exists; spread across multiple fields and dozens of organizations.**
- **NSWCDD searchable database currently contains test results for:**
 - **AlumiPlate**
 - **Ni-PTFE**
 - **Zn-Ni**
- **Reports generated by user criteria:**
 - **Coating**
 - **Tests performed**
 - **Sample type: connector, lab coupon, fastener, etc.**
 - **Including specific connector, e.g. M38999**

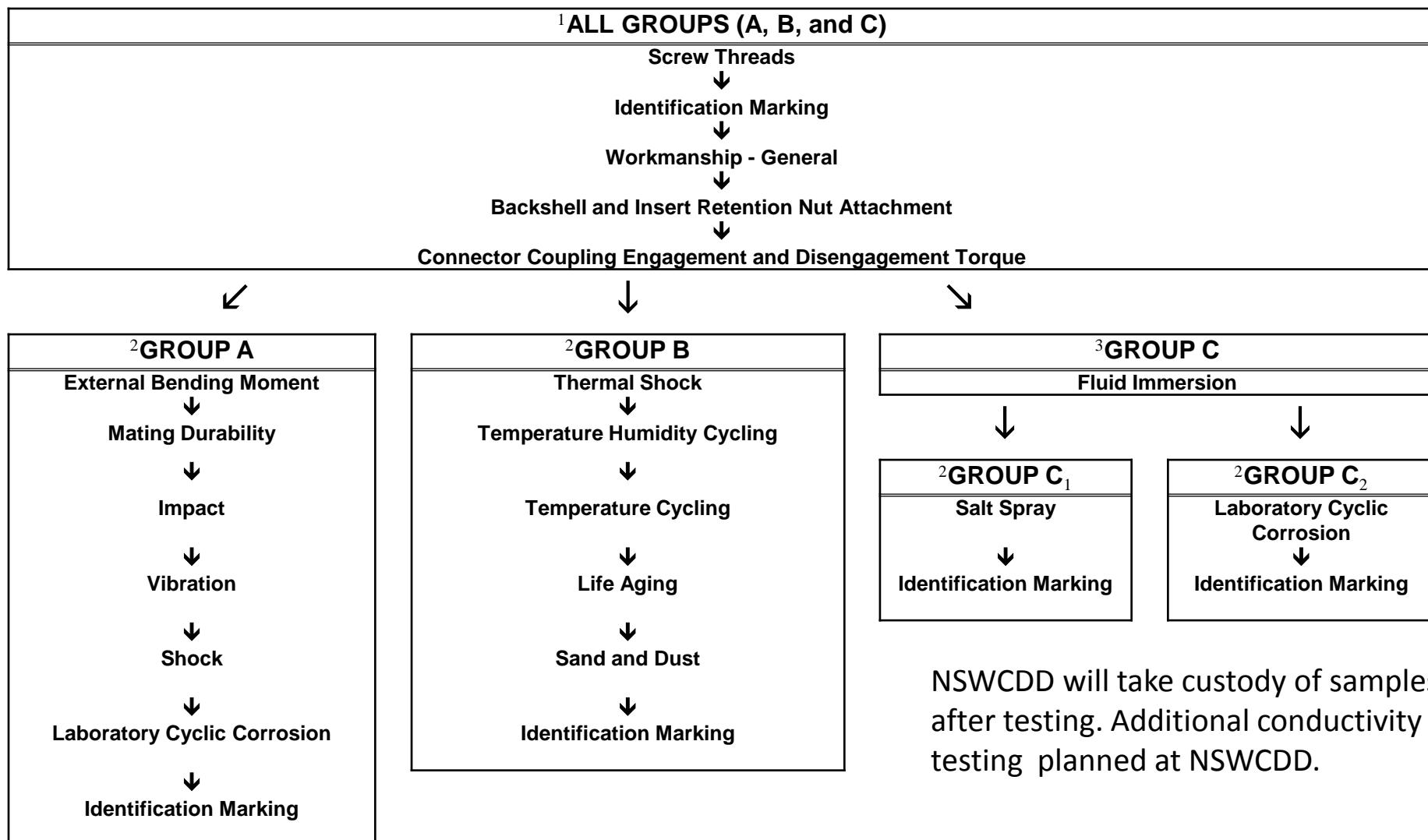
Understanding the Data

- **Variety leads to variability.**
 - Increasingly complex chemical formulations and processes
 - Multiple coating types increase risk of incompatibility
- **Only cadmium behaves like cadmium.**
 - Differences in corrosion mechanisms, oxides, surface chemistries
- **Contradictory data may indicate different conditions:**
 - Variability in coating process
 - Variability in test process
- **Document, document, document!**

Expect the unexpected.

NSWCDD Test Efforts for M28876 Fiber Optic Connectors

- **Primary goals of test effort**
 - **Identify candidate(s) for full qualification of M28876 fiber optic connectors**
 - **Seventeen coatings initially identified, representing eight types of coatings**
 - 340 connector pairs with backshells
 - **Candidates for full qualification will undergo compatibility testing**
 - **Utilize data to provide overarching guidance for all Navy connectors**
 - **Overall coating performance by type**
 - **What to test**
 - Qualification by similarity
 - **What not to test**
 - **Down selecting coating types**



Wrap Up

- **M28876 testing will provide greater insight into the performance of cadmium alternatives over a broader range of requirements.**
 - Candidate(s) for full qualification
 - Guidance for all Navy connectors
- **Continuing work to gather test reports and data for inclusion in cadmium alternative database.**
 - We're going to need a bigger database.

The challenge is enormous. You are not alone.